

MODES OF COPULATION IN SHORT-HORNED GRASSHOPPERS (ORTHOPTERA: ACRIDIDAE)

BY

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(With a plate)

INTRODUCTION

Very little research work has been done on the copulation of the Acrididae, especially of India. Kunckel d'Herculais (1893-1905) described copulation in the Desert Locust, *Schistocerca gergaria*, and Fedorov (1927) in the Egyptian grasshopper, *Anacridium aegyptium* Linnaeus. Later on, Uvarov (1928) gave a detailed account of the common mode of Acrideid copulation (Mode I or 'riding mode' of present account) in *Schistocerca gregaria*. Jhingran (1944) recorded another mode of copulation (Mode II or 'lateral mode') in *Choroedocus insignis* Thunberg. Katiyar (1952) recorded a third mode of copulation (Mode III or 'hanging mode') in *Parahieroglyphus bilineatus* Bolivar. A critical study of the various modes of copulation suggested that a correlation exists between the relative body-length of the two sexes and the modes of copulation adopted. This is discussed below.

The present account deals with the study of the different modes of copulation in 16 species of Acrididae found around Dehra Dun (Table I). Copulation was observed in the insectary cages as well as in the field under natural conditions.

MODES OF COPULATION IN RELATION TO THE RATIO OF THE BODY-SIZE OF THE TWO SEXES. (TABLE I)

Three main types of copulation have been described so far (*vide supra*). Katiyar (1952) suggested that during copulation the various changes in the position of the males are due to the mechanical difficulty of the male in introducing his aedeagus into the vagina of the female and that this feature is correlated with body-length. When the ratio of ♀:♂ body-length¹ is about 1.07, as in *Schistocerca gregaria*, copulation is by Mode I ('riding mode'). When the ratio is about 1.51 as in *Choroedocus insignis*, copulation is by Mode II ('lateral mode'). When it is about 1.72 as in *Parahieroglyphus bilineatus* Bolivar, copulation is by Mode III ('hanging mode').

¹ This ratio was calculated as follows: Length of the entire body of female. Length of the entire body of male.

These correlations exist in the 16 species studied, as discussed below. The most common mode of copulation is Mode I. Ten species copulated by Mode I, but showed gradual variation depending upon the increase in the ratio of ♀ : ♂ body-length; thus *Schistocerca gregaria* (with the lowest ratio, 1.07) shows the perfect type of Mode I. In this species the male is almost equal in length to the female. The head of the male lies just above the occiput of the female during copulation, and when he lowers his abdomen the aedeagus finds its way into the genitalia of the female easily (Pl., fig. a). This can be taken as the most comfortable posture for the male. The other 9 species (Nos. 2-10, Table I) with the Mode I type of copulation show a gradually increasing variation in the formation of the loop or twist in the male abdomen to achieve coitus, and this is correlated with the above-mentioned ratio. Not only the loop or twist in the abdomen of the male increases gradually as the ratio increases, but also the position of the male changes, the head of the male gradually moves backwards as the ratio increases (Pl., figs. b-d). The ratio is 1.07 in *Schistocerca gregaria*, 1.25 in *Hieroglyphus nigrorepletus*, 1.27 in *Aularches punctatus*, 1.33 in *Eyprepocnemis roseus*, 1.35 in *Spathosternum prasiniferum*, 1.36 in *Ceracris deflorata* and 1.38 in *Hieroglyphus banian*, *Hieroglyphus concolor*, *Cantantops humilis* and *Chrotogonus concavus*.

In *Phlaeoba panteli* (ratio 1.4) the male does not remain on the back of the female as in Mode I, but comes to lie on the dorso-lateral side of the abdomen of the female, with his head just near the hind-femur of the female (Pl., fig. e). It forms an intermediate link between Modes I and II and shows a 'dorso-lateral' mode of copulation.

In *Choroedocus insignis*, Jhingran (1944) recorded the 'lateral' mode of copulation (Mode II) in 4 pairs in the laboratory; the male comes to lie on the lateral side of the female forming an acute angle with the female (Pl., fig. f). The present author has observed this mode in about 200 pairs in the field and in about 40 pairs in the Insectary. Besides this species, this mode of copulation was also observed in another species, *Choroedocus* sp., in three pairs in Bibiwala Forest near Rishikesh (Uttar Pradesh). The ratio of the body-length of the two sexes in these species is 1.51 and 1.52 respectively.

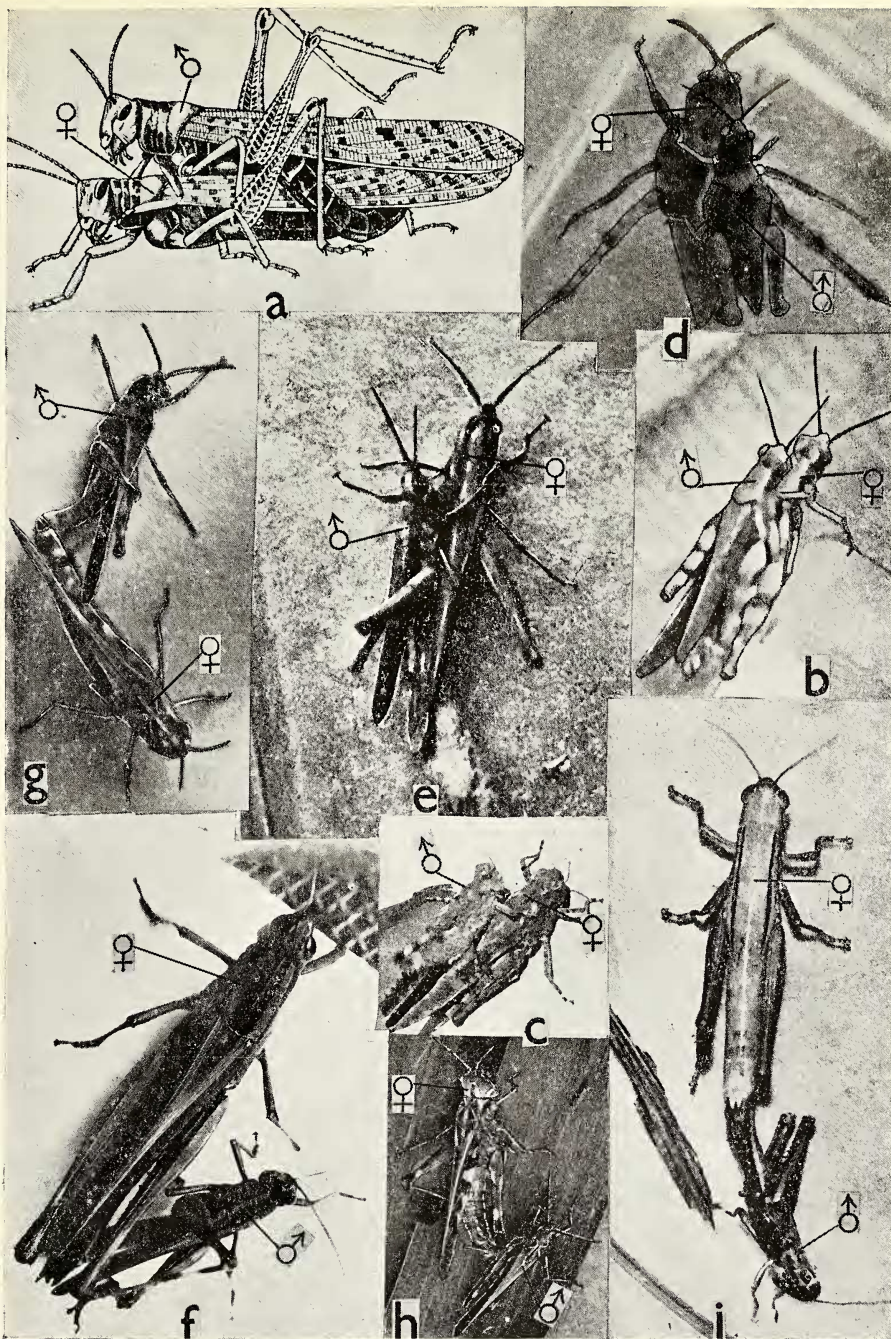
In *Gastrimargus transversus* Thunberg, 2 pairs were observed copulating by 'dorso-lateral' posture (the ratio of the body-length, 1.42). Four other pairs showed copulation by 'lateral posture' (ratio 1.53), and in 4 other pairs the males showed 'hanging posture' when copulating on a leaf; when copulating on the ground, the male forms an obtuse angle with the body of the female during copulation (ratio 1.61). Thus, in the same species as the ratio rises the mode of copulation changes from the dorso-lateral to lateral (Mode II), and from the latter to the hanging type (Mode III).

In *Oedaleus abruptus* (ratio 1.58), during copulation the abdomen of the male forms a curve with the abdomen of the female; or he comes to lie on the opposite side of the female (Pl., figs. g, h), forming an obtuse angle with the body of the female as in *Gastrimargus transversus* (when the ratio was 1.61). But in neither

TABLE I
Correlation between relative body-size of the two sexes and the mode of copulation in Acrididae.

| Species | Female | | Male | | Ratio | Mode of copulation |
|--|---------------|-----------------------------|---------------|-----------------------------|----------------|---|
| | No. of counts | Average body length in mm.* | No. of counts | Average body length in mm.* | In body length | |
| 1. <i>Schistocerca gregaria</i> Forskal ... | 5 | 58.42 | 5 | 54.50 | 1.07 | Mode I 'riding'. |
| 2. <i>Hieroglyphus nigrorepletus</i> Bolivar ... | 8 | 40.70 | 8 | 32.70 | 1.25 | Copulated by Mode I, but showed gradual variation, depending upon the increase in the ratio of the body length. |
| 3. <i>Aularches punctatus</i> Drury ... | 19 | 55.50 | 19 | 43.70 | 1.27 | |
| 4. <i>Eyprepocnemis roseus</i> Uvarov ... | 10 | 25.40 | 10 | 18.90 | 1.33 | |
| 5. <i>Spathosternum prasinerum</i> Walker ... | 15 | 19.04 | 15 | 14.05 | 1.35 | |
| 6. <i>Ceracris deflorata</i> Brumer... .. | 7 | 29.70 | 7 | 21.80 | 1.36 | |
| 7. <i>Hieroglyphus banian</i> Fabricius ... | 12 | 40.50 | 12 | 29.20 | 1.38 | |
| 8. <i>Hieroglyphus concolor</i> Herbst ... | 14 | 54.25 | 14 | 39.10 | 1.38 | |
| 9. <i>Catantops humilis humilis</i> Serville ... | 17 | 29.30 | 17 | 21.20 | 1.38 | |
| 10. <i>Chrotogonus concavus</i> Kirby ... | 18 | 18.17 | 18 | 13.11 | 1.38 | |
| 11. <i>Phlaeoba panteli</i> Bolivar ... | 10 | 27.60 | 10 | 19.70 | 1.40 | |
| 12. <i>Choroedocus insignis</i> Thunberg ... | 32 | 59.50 | 32 | 39.50 | 1.51 | Mode II or 'lateral'. |
| 13. <i>Choroedocus</i> sp. ... | 3 | 50.50 | 3 | 33.15 | 1.52 | |
| 14. <i>Gastrimargus transversus</i> Thunberg ... | 2 | 36.10 | 2 | 25.40 | 1.42 | 'Dorso-lateral'. |
| | 4 | 37.50 | 4 | 24.60 | 1.53 | Mode II 'lateral'. |
| | 4 | 37.42 | 4 | 23.25 | 1.61 | Between Modes II and III. |
| 15. <i>Oedaleus abruptus</i> Thunberg ... | 8 | 23.18 | 8 | 14.52 | 1.58 | Between Modes II and III. |
| 16. <i>Parahieroglyphus bilineatus</i> Bolivar ... | 25 | 36.90 | 25 | 21.40 | 1.72 | Mode III or 'hanging'. |

* (Measurements were taken in actually copulating pairs in the Insectary as well as in the field)



EXPLANATION OF PLATE

- (a) *Schistocerca gregaria* Forskal in copulation (After Kunckel, reproduced from Uvarov, 1928).
 (b) *Catantops humilis humilis* Serville in copulation.
 (c) *Sphingonotus indus* Saussure in copulation on a leaf.
 (d) *Chrotogonus concavus* Kirby in copulation on the ground.
 (e) *Phlaeoba panteli* Bolivar in copulation.
 (f) *Choroedocus insignis* Thunberg in copulation (Original photograph by Dr. V. G. Jhingran, reproduced by his kind permission).
 (g) *Oedaleus abruptus* Thunberg in copulation on the ground.
 (h) *Oedaleus abruptus* Thunberg in copulation on a leaf.
 (i) *Parahieroglyphus bilineatus* Bolivar in copulation on the ground.

The larger insect is ♀, the smaller ♂

